

U.S. Patent Application Serial No. 10/821,089  
Filed: April 19, 2004, Inventor: James Wagner Larsen  
For: Systems and Methods Useful For Detecting Presence  
And/Or Location Of Various Materials  
Attorney: James L. Ewing, IV, Telephone: 404.815.6494  
Attorney Docket No. 14088/299978  
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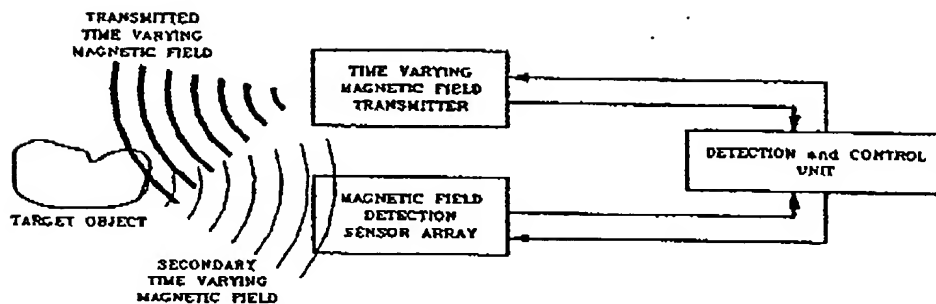


FIGURE 1-1 SYSTEM BLOCK DIAGRAM

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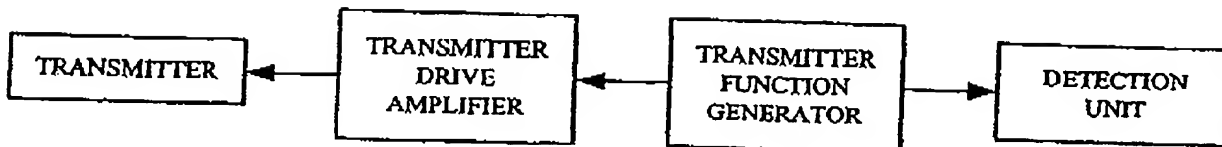


FIGURE 1-2  
TRANSMITTER WITH KNOWN OUTPUT FUNCTION

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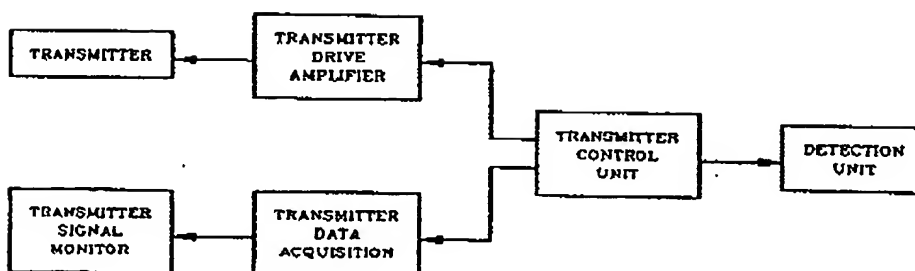


FIGURE 1-3  
TRANSMITTER WITH MAGNETIC FIELD MONITOR

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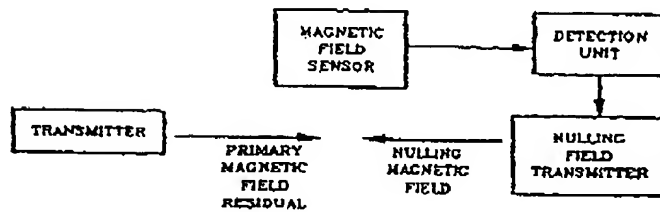


FIGURE 1-4A  
RESIDUAL MAGNETIC FIELD NULLING  
USING A NULLING MAGNETIC FIELD

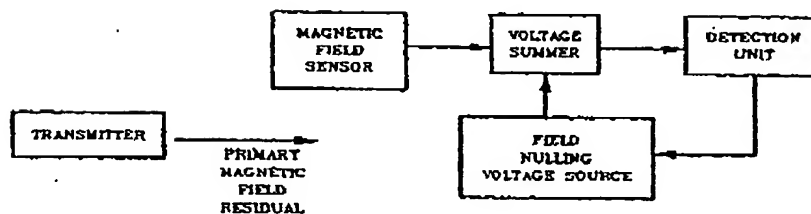


FIGURE 1-4B  
VOLTAGE NULLING OF RESIDUAL FIELD SENSOR OUTPUT

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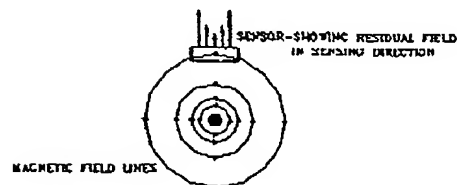


FIGURE 1-5A  
 TRANSMITTER COIL CROSS SECTION FOR SINGLE WIRE COIL  
 SHOWING SENSOR POSITION AND RESIDUAL FIELD

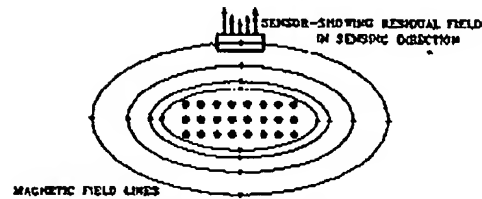


FIGURE 1-5B  
 TRANSMITTER COIL CROSS SECTION FOR NORMAL RECTANGULAR COIL  
 SHOWING SENSOR POSITION AND RESIDUAL FIELD

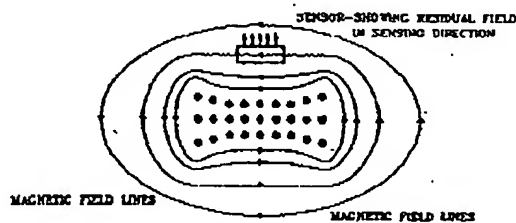


FIGURE 1-5C  
 TRANSMITTER COIL CROSS SECTION FOR SHAPED COIL  
 SHOWING SENSOR POSITION AND RESIDUAL FIELD

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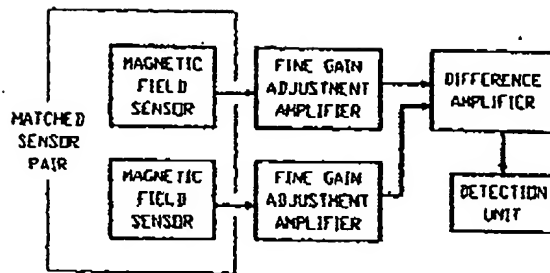


FIGURE 1-6  
GRADIENT SENSING USING A MATCHED SENSOR PAIR

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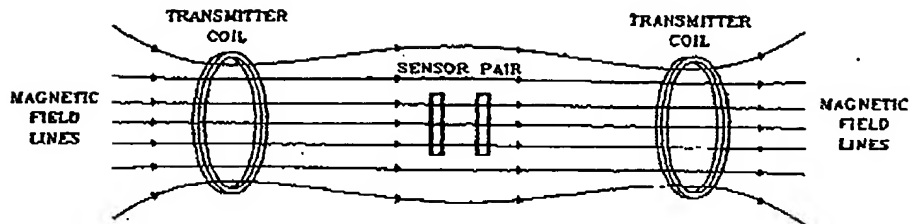


FIGURE 1-7  
SENSOR PAIR CALIBRATION  
USING TWO TRANSMITTER EQUAL COILS

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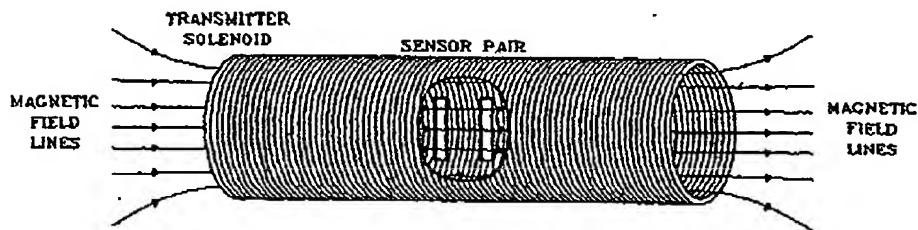


FIGURE 1-8  
SENSOR PAIR CALIBRATION  
USING A LARGE SOLENOID COIL



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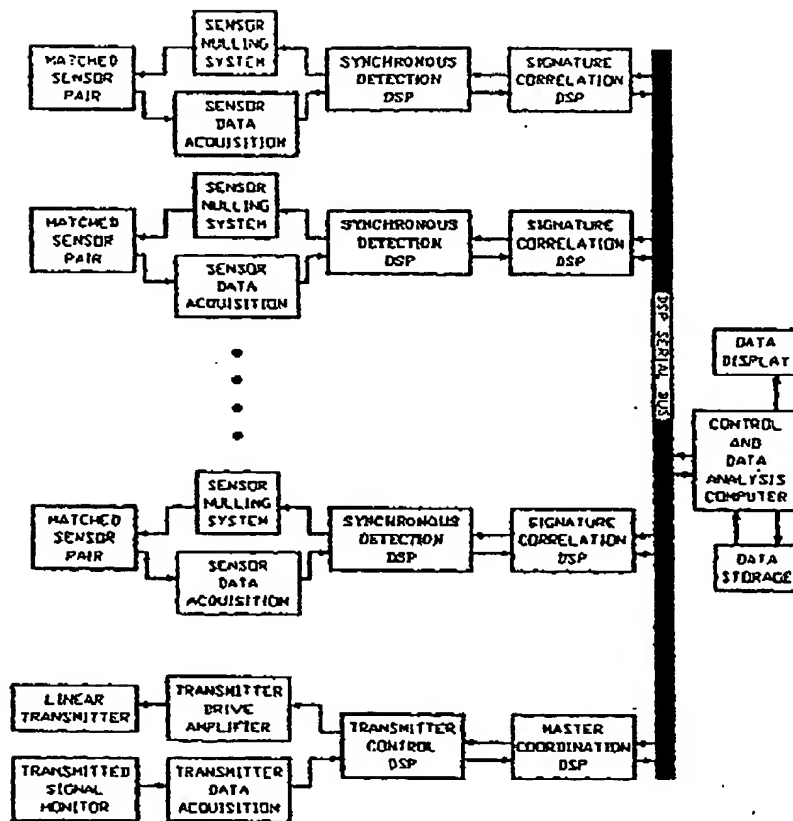


FIGURE 1-9  
 SYSTEM WITH MULTIPLE SENSOR PAIRS  
 AND SYNCHRONOUS DETECTION  
 BASED ON DSP PROCESSORS

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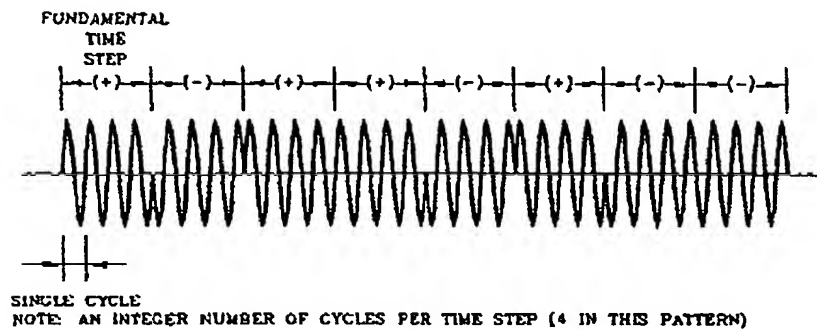


FIGURE 1-10  
AN 8 SECTION (+ - + + - + - -)  
TIME ENCODED WAVEFORM

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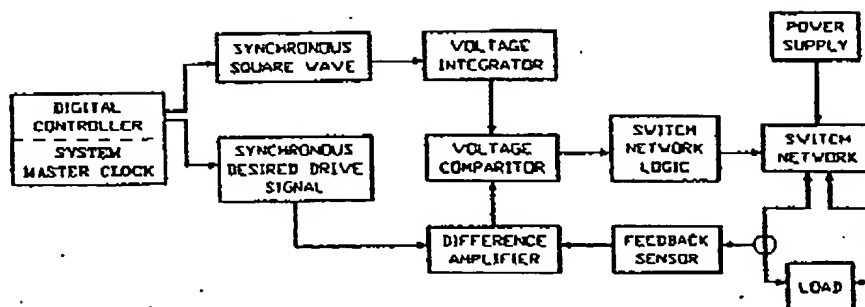


FIGURE 2-1  
SYNCHRONOUS PULSE WIDTH MODULATION AMPLIFIER

U.S. Patent Application Serial No. 10/827,089  
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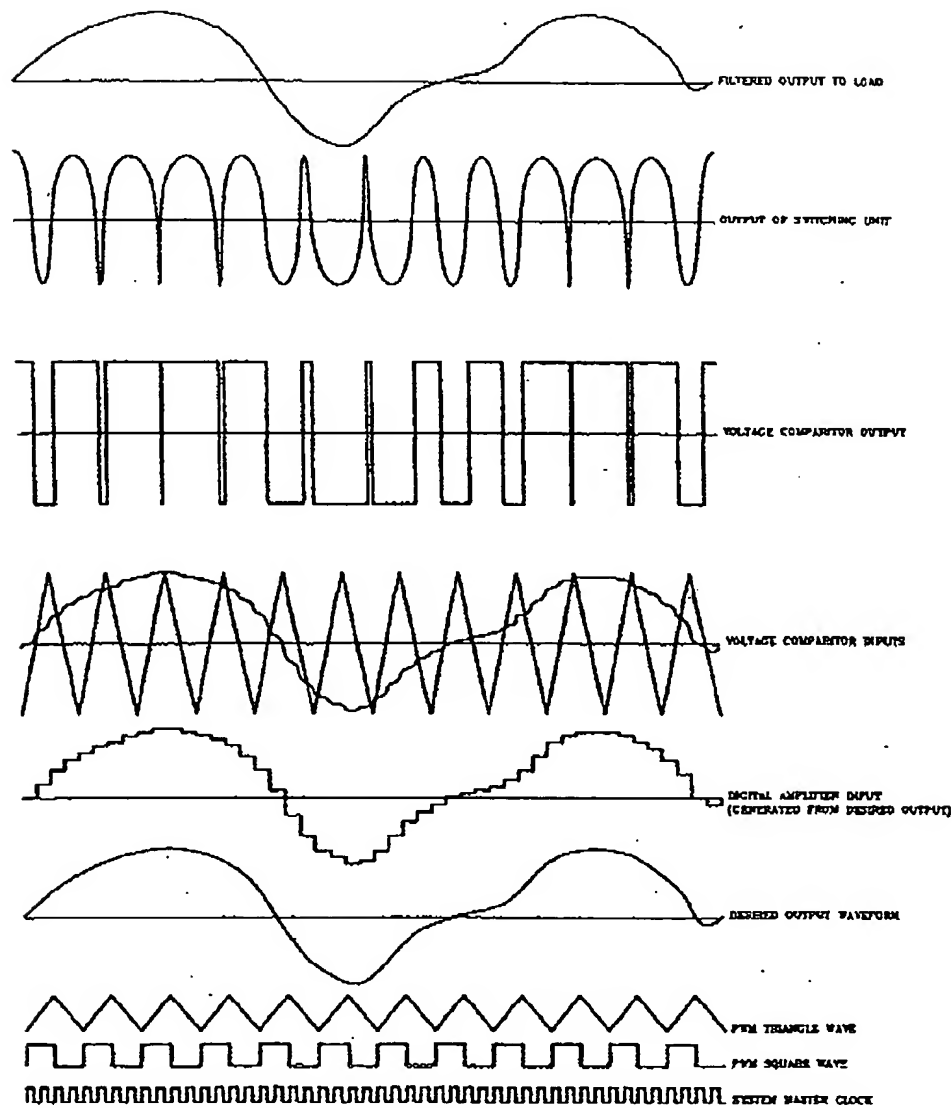


FIGURE 2-2  
 TYPICAL PULSE WIDTH MODULATION WAVEFORMS

U.S. Patent Application Serial No. 10/827,039  
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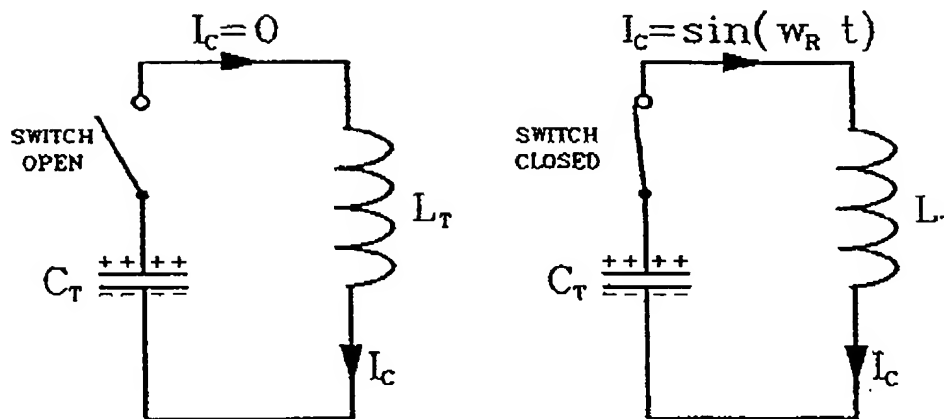


FIGURE 4-1  
WHEN SWITCH IS CLOSED CIRCUIT OSCILLATES  
AT RESONANT FREQUENCY,  $w_R$

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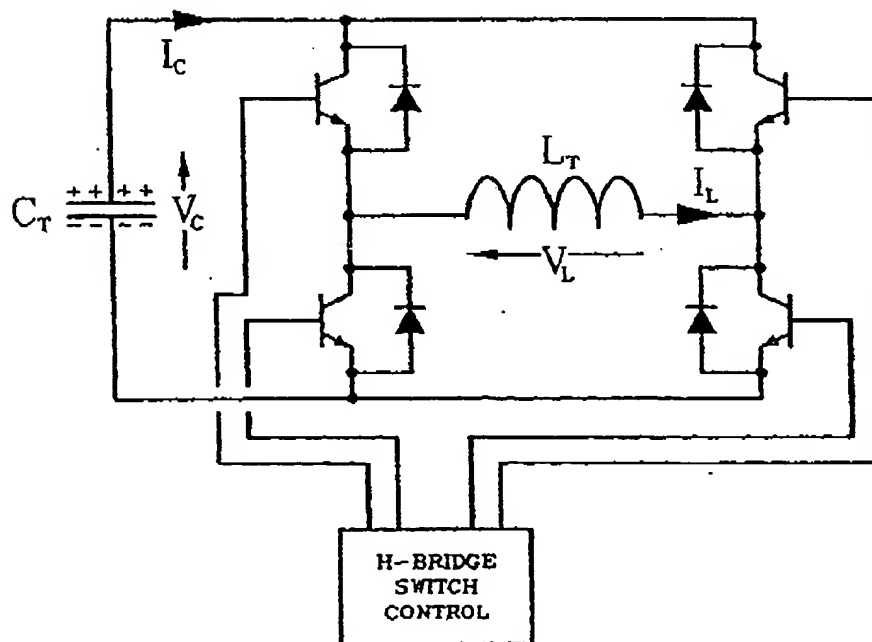


FIGURE 4-2  
 AN H-BRIDGE SWITCH NETWORK  
 CONNECTING THE CHARGED CAPACITOR  
 TO THE LOAD COIL

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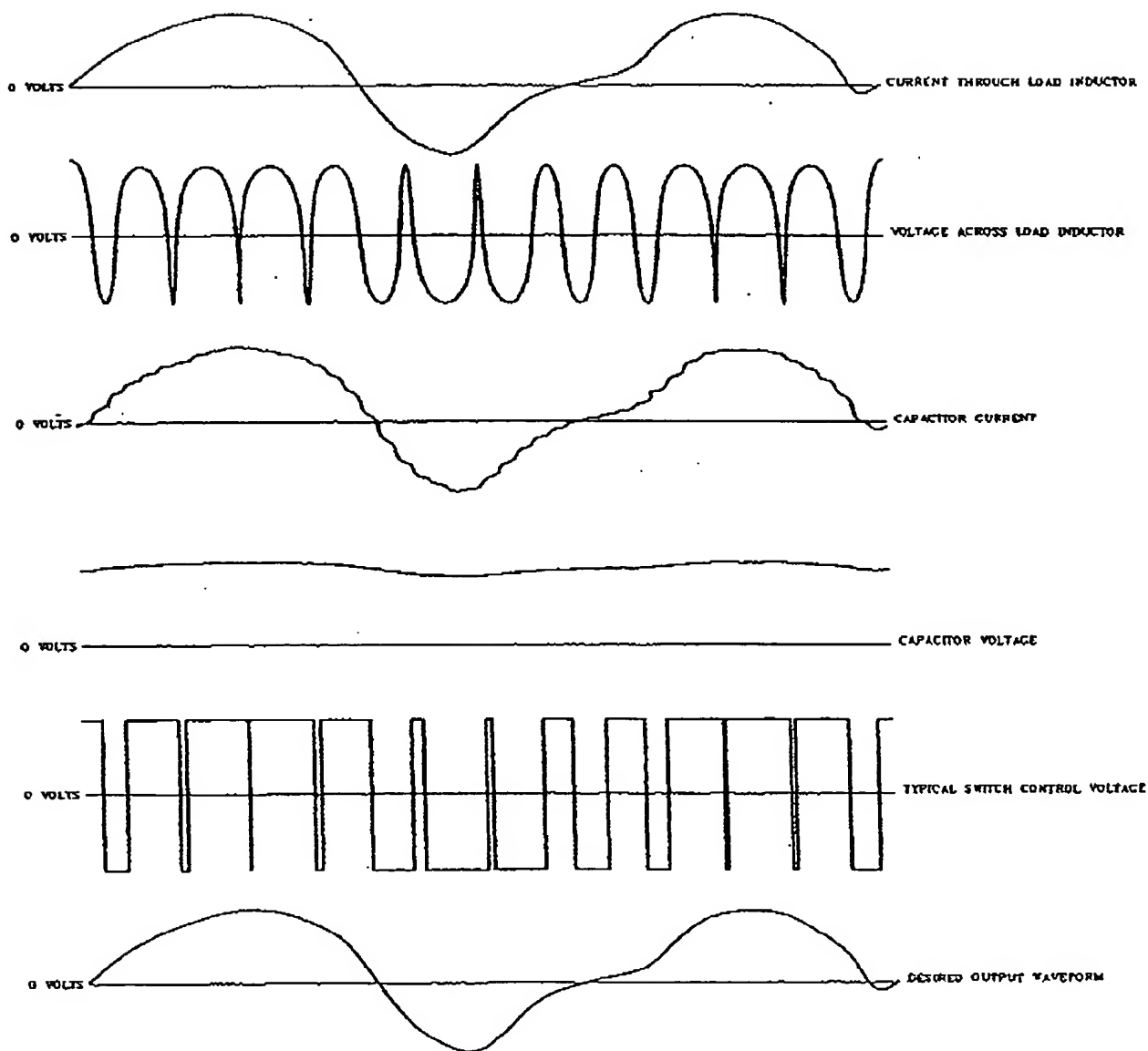


FIGURE 4-3  
SWITCHED CAPACITOR CIRCUIT WAVEFORMS

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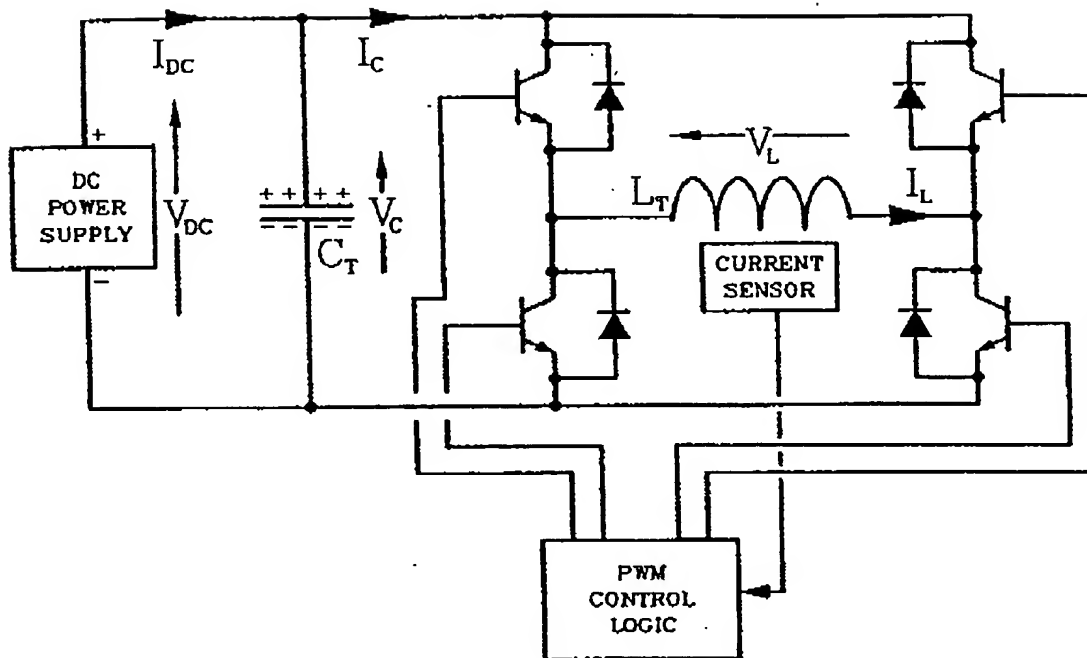


FIGURE 4-4  
 PULSE WIDTH MODULATED  
 SWITCHED CAPACITOR RESONATOR



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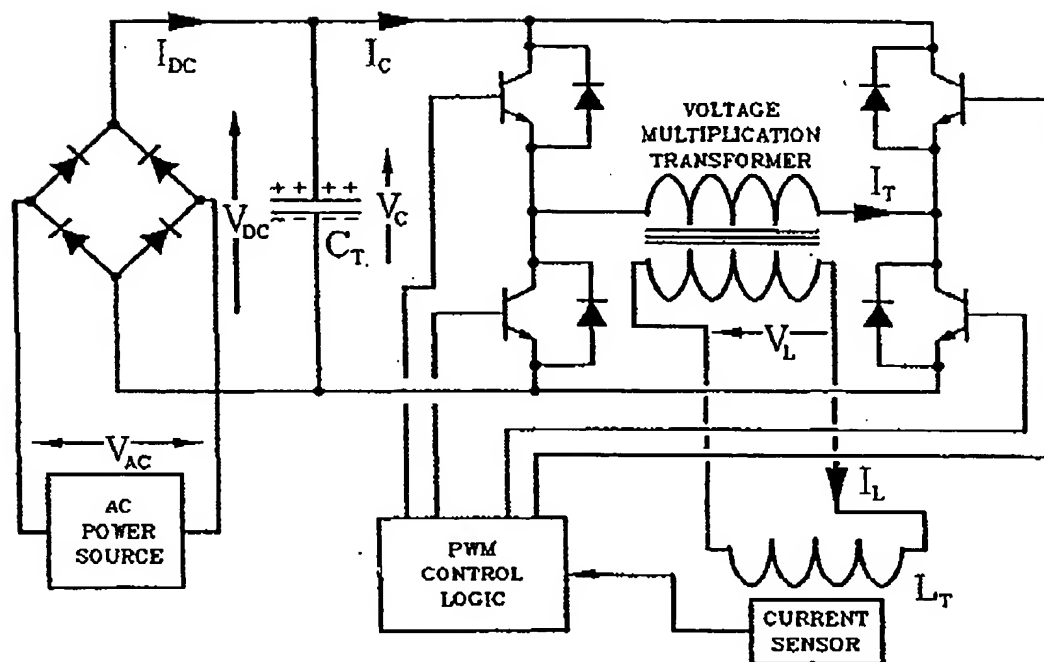


FIGURE 4-5  
 SWITCHED CAPACITOR RESONATOR  
 WITH INTEGRAL SWITCHING POWER SUPPLY

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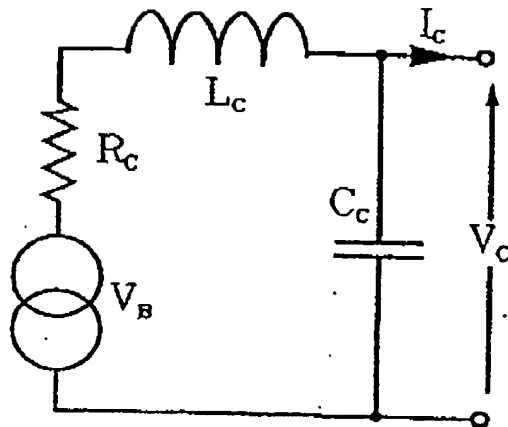


FIGURE 5-1  
SENSE COIL EQUIVALENT CIRCUIT

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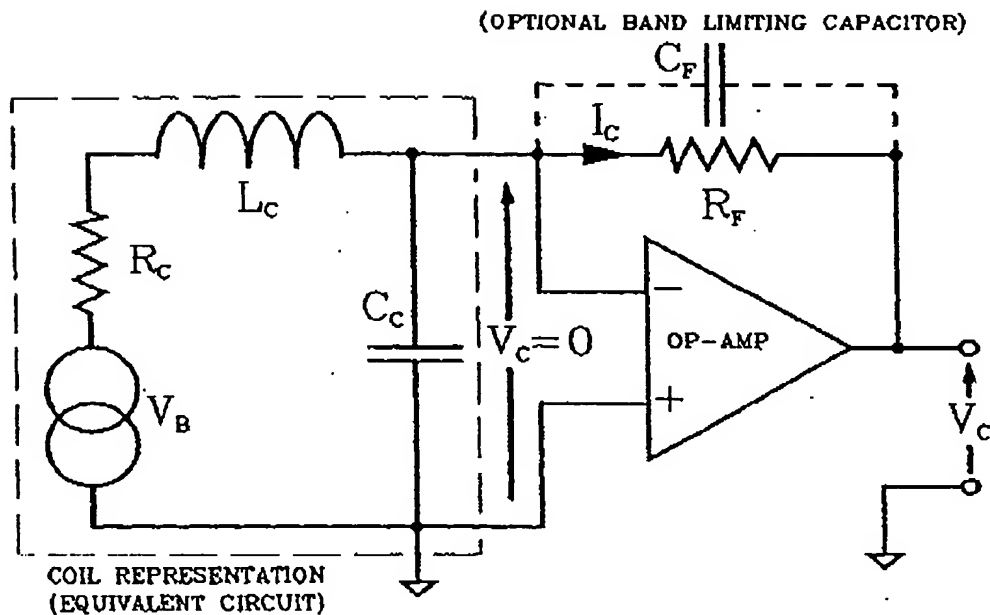


FIGURE 5-2  
OPERATIONAL AMPLIFIER BASED  
VOLTAGE TO CURRENT CONVERSION CIRCUIT

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SENSITIVITY FOR #32 WIRE WITH Rf+10MOhm

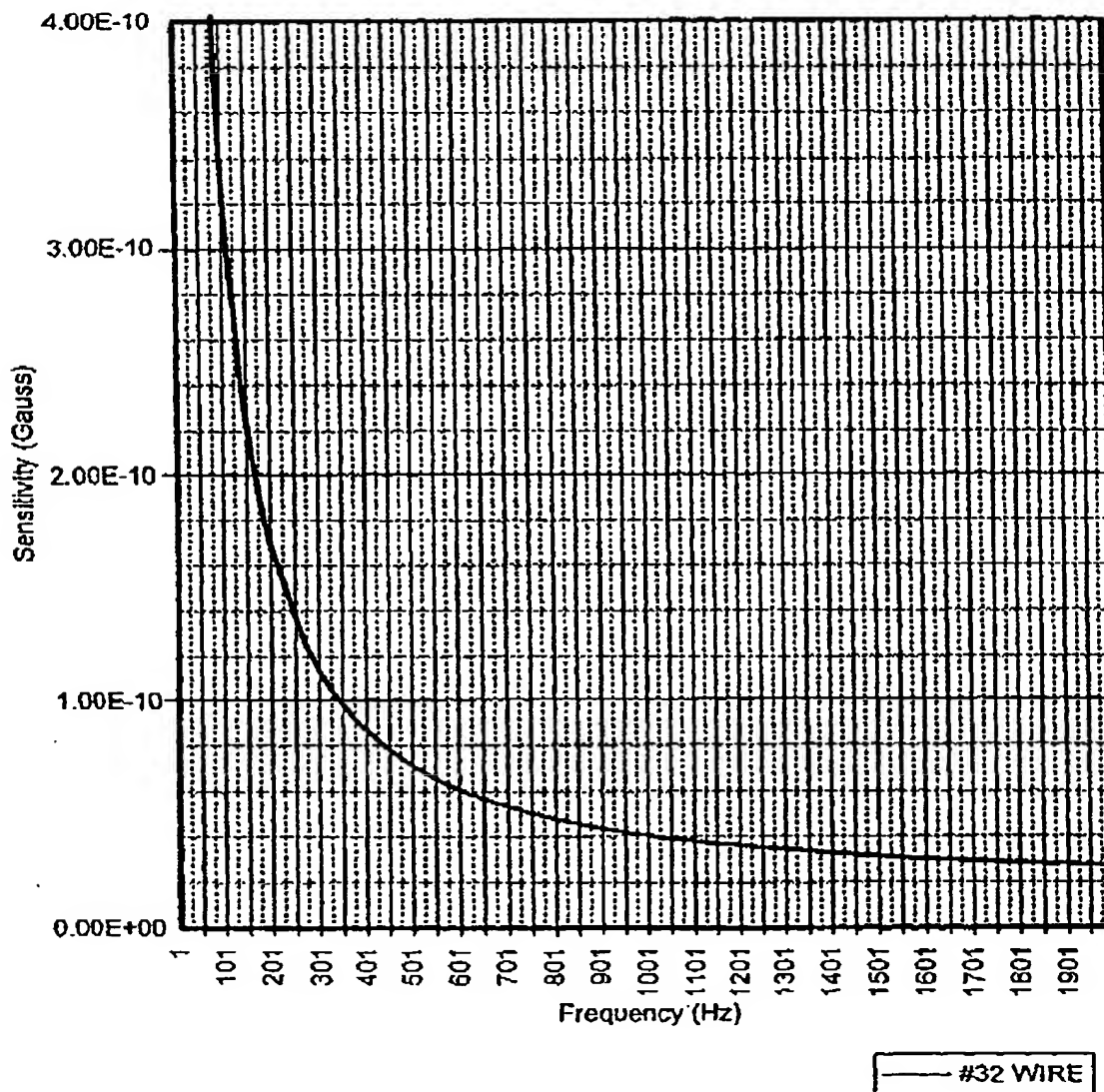


FIGURE 5-3

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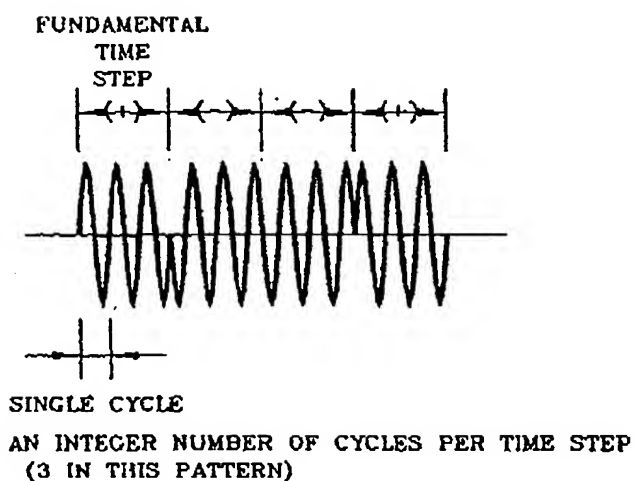
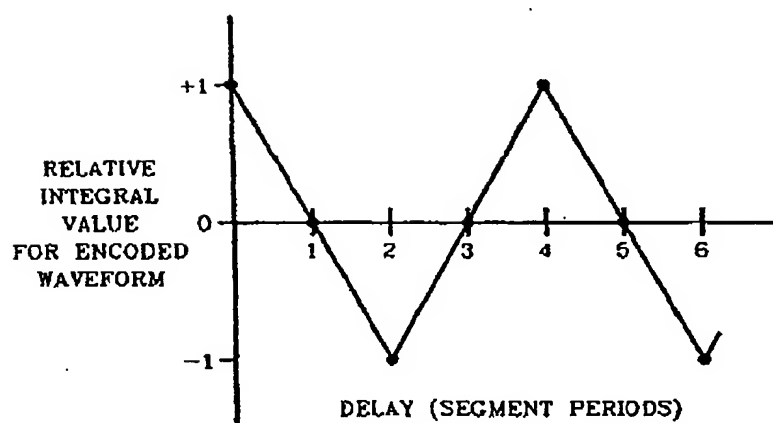


FIGURE 6-1  
A 4 SEGMENT (+ - - +)  
TIME ENCODED WAVEFORM

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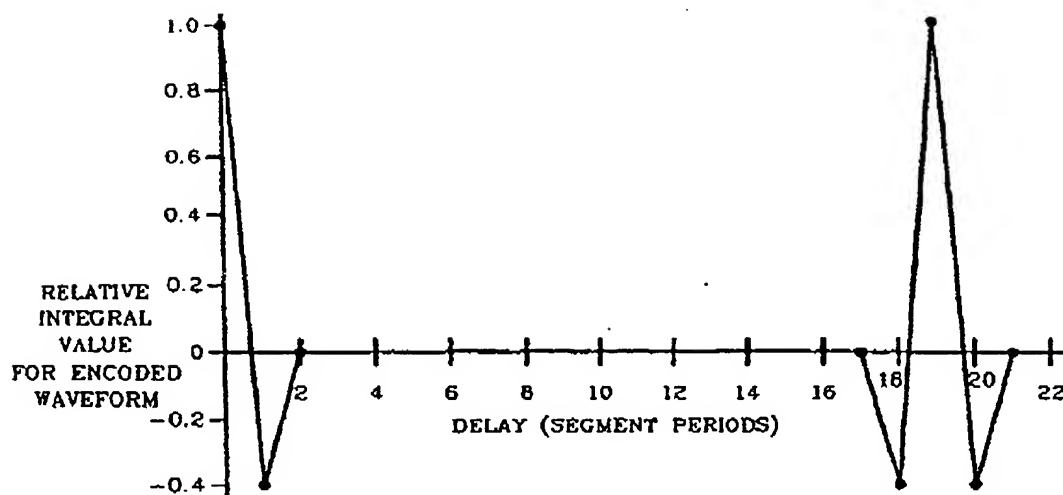


NOTE: THE INTEGRAL OF THIS WAVEFORM WITH A CONTINUOUS SINE WAVE IS ZERO

FIGURE 6-2  
CORRELATION OF THE 4 SEGMENT (+ - - +)  
ENCODED WAVEFORM WITH ITSELF



U.S. Patent Application Serial No. 10/527,039  
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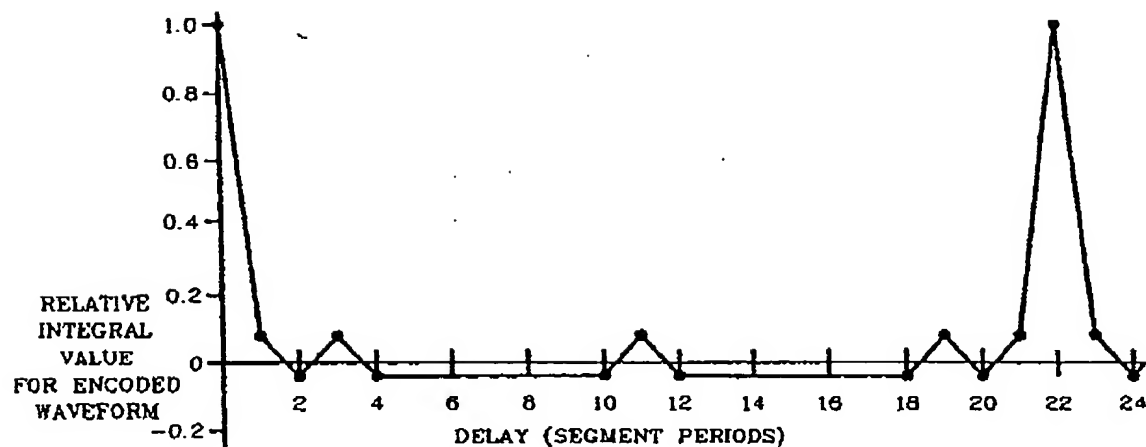


NOTE: THE INTEGRAL OF THIS WAVEFORM WITH A CONTINUOUS SINE WAVE IS -0.1

FIGURE 6-4  
CORRELATION OF THE 20 SEGMENT  
(+ - - - + + - - + - - + - + + - + - + -)  
ENCODED WAVEFORM WITH ITSELF



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NOTE: THE INTEGRAL OF THIS WAVEFORM WITH A CONTINUOUS SINE WAVE IS ZERO

FIGURE 6-5  
CORRELATION OF THE 22 SEGMENT  
(++++- - - - - + - - - + - + + + - - - + + -)  
ENCODED WAVEFORM WITH ITSELF

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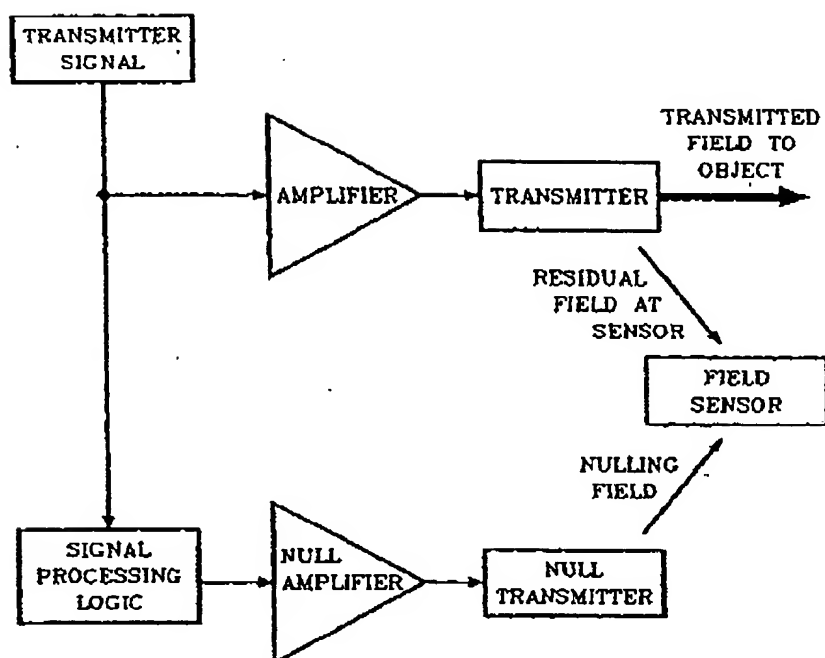


FIGURE 7-1  
LOCAL MAGNETIC FIELD GENERATION  
FOR RESIDUAL FIELD CANCELLATION

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